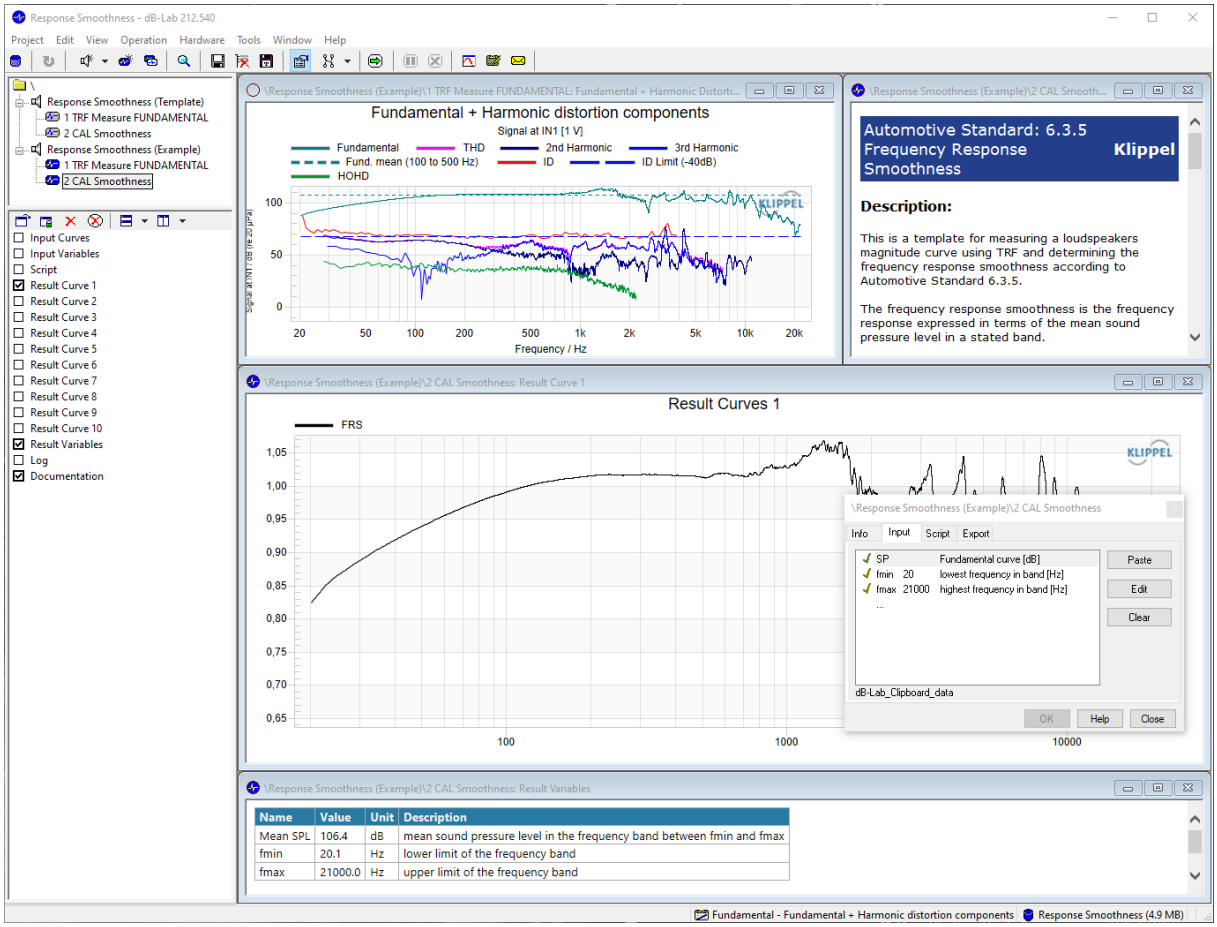
Frequency Response Smoothness AN40

Application Note to the KLIPPEL ANALYZER SYSTEM (Document Revision 1.1)

The frequency response smoothness describes the variation in the amplitude response of a loudspeaker by normalizing the measured response to the mean sound pressure level in a stated frequency band.

This Application Note is a step-by-step introduction to a fast calculation of the Frequency Response Smoothness with the appropriate Klippel Template.



CONTENT

1 Definition

Mean sound pressure level	$p_r = \sqrt{\sum_{i=1}^{n} \frac{p_i^2}{n}}$ $\overline{L_p} = 20\log\frac{p_r}{20\mu\text{Pa}}\text{dB}$	The calculation of the mean sound pressure level is defined according to IEC standard 60268-5 in paragraph 20.6 [4] as the Root Mean Square values of equal logarithmical frequency bands. (p_i is the sound pressure in a definite 1/k octave band) The mean sound pressure level will be calculated afterward from the mean sound pressure.
Frequency Response Smoothness	$d_{FRS}(f) = \frac{L_p(f)}{\overline{L_p}}$	The frequency response smoothness is defined as the frequency response (L_p) referred to the mean sound pressure level $\overline{L_p}$ in a stated frequency band.

2 Requirements

Start-Up	To measure and calculate the Effective Frequency Range the following equipment is required: • Install the RnD Analysis Software on your computer • Create a new object and select *Response Smoothness* to start the analysis • Enter the sensitivity of the microphone in the property page *Input* for the *TRF Measure FUNDAMENTAL* or use a pistonphone to calibrate the microphone.

3 Procedure

TRF Measurement	**Motivation:** We start with a simple sinusoidal sweep measurement to gain the Transfer Function of the Loudspeaker. **How to do it:** Adjust the measurement microphone normally to the driver as preferred and select the *TRF Measure FUNDAMENTAL* operation. In *Properties* → *Stimulus* set F_{min} to a lower and F_{max} to a higher value than the boundary frequencies of the required working range and modify the voltage if necessary. Run the measurement. Select the curve "*Fundamental*" from the window *Fundamental + Harmonic distortion components* and copy it to the clipboard.
CAL Smoothness	**Motivation:** The frequency response smoothness can easily be calculated by the *CAL Smoothness* operation. **How to do it:** Select *SP* in *Properties* → *Input* and paste the Fundamental curve from Clipboard. Enter your frequency bounds f_{min} and f_{max} which determines the averaging band as preferred. Usually, they should correspond with the bounds of the required working range of the loudspeaker.
Results	After running the script, the result curve window will appear showing the frequency response smoothness according to the standard absolute value which allows you to evaluate the balance characteristic. At a mean SPL of 100 dB, a smoothness curve between 0.94 and 1.03 corresponds with a variation of the SPL curve by 6 dB. The window *Result Variables* display the Mean SPL according to IEC 20.6 in the frequency band between f_{min} and f_{max}. These bounds usually resemble your entered parameters but might deviate if they exceeded the bounds of the fundamental curve.

4 More Information

Standard	[4] IEC Standard 60268 Sound System Equipment – Part 5 Loudspeakers, 20.6 Mean sound-pressure level in a stated frequency band

Find explanations for symbols at:

http://www.klippel.de/know-how/literature.html

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